



ELECTRONIC CIGARETTES: AN OVERVIEW OF KEY ISSUES

A significant number of adults and youth are using electronic cigarettes, which provide a relatively new way to deliver the addictive substance nicotine without burning tobacco. A 2018 report from the National Academies of Sciences, Engineering, and Medicine (NASEM) found that e-cigarettes are less harmful than cigarettes, but are not risk-free.¹ The report also found that many questions remain about the long-term health effects of these products for individual users and about the population-wide effects. Research is still needed to determine whether or not e-cigarettes will help people quit, discourage smokers from quitting completely, or lead to nicotine addiction and established tobacco use for new users, including kids, especially in an environment where the products continue to evolve. In 2016, the Surgeon General stated that “e-cigarette use among U.S. youth and young adults is now a major public health concern.”² The Surgeon General noted that while we continue to learn more about e-cigarettes, “we currently know enough to take action to protect our nation’s young people from being harmed by these products.”

What are Electronic Cigarettes?

The term “electronic cigarettes” covers a wide variety of products now on the market, from those that look like cigarettes or pens to somewhat larger products like “personal vaporizers” and “tank systems.” Instead of burning tobacco, e-cigarettes most often use a battery-powered coil to turn a liquid solution into an aerosol that is inhaled by the user. There are a wide range of reusable e-cigarettes, which enable users to replace a nicotine-containing cartridge or refill a tank with a liquid solution, and there are disposable e-cigarettes, which cannot be refilled. Also growing in popularity are “mods,” which are units that users assemble themselves from separate component parts, to allow variation in battery power, style, and size.³ A 2014 study found more than 460 brands of e-cigarettes available for purchase online, with the number increasing by an average of more than ten brands per month.⁴

The liquid solution used in e-cigarettes typically contains nicotine, propylene glycol, glycerin or some other solvent, and other additives. E-cigarettes and refill liquids or cartridges often contain flavorings, including fruit and candy flavorings that are not permitted in regular cigarettes. Many e-cigarettes and their refill liquids also come in sweet flavors, such as chocolate, gummi bear, chocolate chip cookies, and strawberry, which have long been considered attractive to kids. By January 2014, researchers were able to identify more than 7,700 unique e-cigarette flavors available online, with an average of more than 240 new flavors being added per month.⁵ In addition to the vast selection available online, thousands of “vape” shops have now opened throughout the country that allow consumers to sample and purchase refill liquids, including a combination of flavors chosen by the user and in varying levels of nicotine.



* For the purposes of this factsheet, the term “e-cigarettes” will be used to represent the entire category of products.

The e-cigarette market is projected to reach \$5.1 billion in the U.S. in 2018.⁶ While the e-cigarette market was originally dominated by companies whose primary product was e-cigarettes, the three major U.S. tobacco companies – Altria/Philip Morris, Reynolds American/Lorillard and ITG Brands – have all invested in the e-cigarette market with their own brands. There are, however, hundreds of e-cigarette companies and thousands of “vape shops” in the U.S. market, leading to a wide variety of product characteristics, including ingredients and nicotine content. A large proportion of e-cigarettes in the U.S. market are imported. Globally, more than 95 percent of e-cigarettes are estimated to be manufactured in China.⁷ For those that are domestically produced or assembled, certain components and ingredients are still manufactured abroad.⁸

E-Cigarette Marketing

The 2016 Surgeon General report stated that, “E-cigarettes are marketed by promoting flavors and using a wide variety of media channels and approaches that have been used in the past for marketing conventional tobacco products to youth and young adults.”⁹ An investigative report released in April 2014 by 11 members of Congress¹⁰ provided detailed evidence that e-cigarette manufacturers resurrected the marketing practices used by tobacco companies for decades to attract kids to smoking – including some tactics that have been prohibited for tobacco companies precisely because they appealed to kids.

Some e-cigarette marketing tactics include ads that reach youth audiences; sponsorships and free samples at youth-oriented events such as auto races and music festivals; celebrity spokespeople who depict e-cigarette smoking as glamorous; social media marketing; and sweet, kid-friendly flavors with names like Cherry Crush, Chocolate Treat, Cotton Candy, and Gummy Bear.

Unlike cigarette and smokeless tobacco companies, e-cigarette companies are not currently required to report their marketing and promotional expenditures to the U.S. Federal Trade Commission (FTC), so the exact amount spent to advertise and promote these products is uncertain. However, e-cigarette marketing expenditures are estimated to have increased dramatically in the early years, from \$12 million in 2011 to \$125 million in 2014.¹¹ Other studies have also documented this significant increase in spending.¹² These figures likely underestimate the true extent of e-cigarette advertising, as the available marketing data are not comprehensive (e.g., social media and sponsored events—strategies widely used by numerous e-cigarette companies—are not included). Additionally, the nationwide rollout of the Vuse and MarkTen brands did not occur until mid-2014, so the full impact of these brands on e-cigarette marketing expenditures is unknown.

These advertising efforts have effectively reached youth and young adults. The Surgeon General concluded that, “E-cigarettes are marketed in a wide variety of channels that have broad reach among youth and young adults.”¹³ The 2016 National Youth Tobacco Survey (NYTS) found that 78.2 percent of middle and high school students—20.5 million youth—had been exposed to e-cigarette advertisements from at least one source.¹⁴ Another study found that 82 percent of 12-17 year olds and 88 percent of 18-21 year olds reported seeing e-cigarette advertising in 2015.¹⁵ A 2016 study in *Pediatrics*, analyzing 2014 YTS data, found that exposure to e-cigarette advertising is associated with current e-cigarette use among youth and that greater exposure to e-cigarette advertising is associated with higher odds of use.¹⁶

Use of E-Cigarettes Among Adults and Youth

E-cigarette use among youth exceeds the use of cigarettes and other tobacco products. While the most recent data indicate that e-cigarette use among youth may have peaked, the number of youth using e-cigarettes is alarming and raises serious concerns. It is still an open scientific question whether e-cigarettes might be able to help adult smokers give up cigarettes; however, kids should not be using any tobacco product, including e-cigarettes.

Youth Use. Data from the National Youth Tobacco Survey (NYTS), released by the U.S. Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA), show that youth use of electronic cigarettes declined for the first time in 2016.¹⁷ This finding is consistent with other national data from the Monitoring the Future survey which found a significant decline in vaping from 2015 to 2016 among 8th, 10th, and 12th graders.¹⁸ However, both surveys found that e-cigarette use continues to exceed use of cigarettes and other tobacco products.

According to the NYTS, 11.3 percent of high schoolers and 4.3 percent of middle schoolers reported current use of e-cigarettes in 2016.¹⁹ E-cigarette use among high school students declined significantly from 2015 to 2016, the first decline in youth e-cigarette use after it had increased ten-fold from 2011 to 2015 (it was just 1.5% in 2011).²⁰ Current use is defined as use on at least one day in the past 30 days. According to the NYTS, over 1.6 million high school students and 500,000 middle school students currently use e-cigarettes. Since the survey also found that over 1.4 million youth smoke cigarettes, this means that at least 750,000 current e-cigarette users do not smoke cigarettes.²¹

Among those students who had used e-cigarettes in the past 30 days in 2014, 15.5 percent of high schoolers and 11.8 percent of middle schoolers were frequent users of e-cigarettes, using e-cigarettes on at least 20 of the preceding 30 days. This amounts to an estimated 340,000 middle and high school students who were frequent users of e-cigarettes. More than a quarter of high school e-cigarette users had used e-cigarettes on at least ten days in the previous month.²²

Multiple national surveys show that flavored e-cigarettes are popular among youth. Data from FDA's 2013-2014 Population Assessment of Tobacco and Health (PATH) survey found that 81 percent of youth aged 12-17 who had ever used e-cigarettes had used a flavored e-cigarette the first time they tried the product, and that 85.3 percent of current youth e-cigarette users had used a flavored e-cigarette in the past month. Moreover, 81.5 percent of current youth e-cigarette users said they used e-cigarettes "because they come in flavors I like."²³ While the methodology is not comparable to the PATH study, an analysis of the 2015 NYTS found that 44.6 percent of middle and high school e-cigarette users—totaling 1.26 million youth—had used a flavored e-cigarette in the past month.²⁴

Adult Use. Data from the National Health Interview Survey (NHIS) show that in 2016, 3.2 percent of adults currently used e-cigarettes every day or some days (it was 3.5 percent in 2015) and 15.4 percent of adults had ever tried an e-cigarette.²⁵

E-cigarette use is higher among younger adult populations. According to the 2016 NHIS, 23.5 percent of 18-24 year olds had ever tried an e-cigarette and 4.5% currently use e-cigarettes every day or some days.²⁶ Earlier data from the 2015 NHIS showed that 40 percent of young adult e-cigarette users had never been cigarette smokers, raising concerns that e-cigarettes may be attracting young non-smokers to tobacco use.²⁷

Health and Public Health Concerns

Under the right circumstances, e-cigarettes could benefit public health if they help significantly reduce the number of people who use combustible cigarettes and die of tobacco-related disease. According to CDC and the 2018 NASEM report on e-cigarettes, e-cigarettes are less harmful than combustible cigarettes, but that doesn't mean that they are safe or without risk.²⁸ However, the NASEM report stated that "the absolute risks of the products cannot be unambiguously determined at this time."²⁹ Little is known about the long-term effects of e-cigarette use, and there is little data to assess the impact on cancer and heart disease risk. Thus, many questions still remain about the potential long-term risks to the public health posed by these products.

Individual-Level Health Risks

E-cigarette ingredients and constituents. There is insufficient research on the long-term effects of using e-cigarettes, which involves regular inhalation of nicotine, glycerin or some other solvent, and other additives.³⁰ According to the Surgeon General, "E-cigarette aerosol is not harmless. It can contain harmful and potentially harmful constituents, including nicotine."³¹ The nicotine present in e-cigarette aerosol is absorbed by users and bystanders.³² Studies have found other chemicals and toxins present in some e-cigarettes, including formaldehyde, acrolein, volatile organic compounds like toluene, tobacco-specific nitrosamines, and metals like nickel and lead.³³ These compounds are generally present at levels much lower than in cigarette smoke, although the compounds themselves are found on FDA's list of harmful or potentially harmful substances.³⁴ Because FDA has just begun to regulate e-cigarettes, which are available in hundreds of different brands,³⁵ there is no way for consumers to know for sure yet what is in the products or the aerosol.³⁶

In addition, while some of the other substances, such as flavorings, used in e-cigarettes might be labeled as “generally recognized as safe,” some researchers as well as the organization primarily responsible for granting that designation³⁷ have noted that it applies to ingestion, not for other exposures such as inhalation. The NASEM report committee expressed concern about flavor additives because even to-date, they “have not been widely tested for sensitizing, toxic, or irritating potency.”³⁸ In its 2016 report, the Surgeon General stated that, “while some of the flavorings used in e-cigarettes are generally recognized as safe for ingestion as food, the health effects of their inhalation are generally unknown” and noted that some of the flavorings found in e-cigarettes have been shown to cause serious lung disease when inhaled.³⁹ An article in the *Journal of the American Medical Association* raised concerns that the chemical flavorings found in some e-cigarettes and e-liquids could cause respiratory damage when the e-cigarette aerosol is inhaled deeply into the lungs.⁴⁰

Impact of Nicotine. E-cigarettes and refill liquids contain widely varying levels of nicotine, and the nicotine delivered through the aerosol can also vary depending on the device characteristics and user practices.⁴¹ While e-cigarettes can be used for non-nicotine products, including marijuana, the vast majority of e-cigarette products sold in traditional retail stores contain nicotine,⁴² and more than two-thirds of youth e-cigarette users report using e-cigarettes exclusively for nicotine-containing products.⁴³ Nicotine is a highly addictive drug that can have lasting damaging effects on adolescent brain development and has been linked to a variety of adverse health outcomes for the developing fetus.⁴⁴ The Surgeon General concluded that, “The use of products containing nicotine poses dangers to youth, pregnant women, and fetuses. The use of products containing nicotine in any form among youth, including in e-cigarettes, is unsafe.”⁴⁵

In general, nicotine has been found to impact the cardiovascular system.⁴⁶ The NASEM report found that the nicotine in e-cigarettes can increase heart rate and diastolic blood pressure in users shortly after use, but evidence was not available to determine an association between e-cigarette use and other cardiovascular outcomes such as heart disease and stroke. However, the NASEM report acknowledged that the nicotine in e-cigarettes could elevate cardiovascular disease risk in users with pre-existing cardiovascular disease.⁴⁷

Poisoning and Exposure to Liquid Nicotine. Delivered in high doses, nicotine can be lethal. The Surgeon General’s report and the NASEM report both found that contact with e-liquids can cause adverse health effects and ingesting e-liquids can lead to death.⁴⁸ Exposure to liquid nicotine found in e-cigarettes has resulted in thousands of calls to poison control centers in recent years, peaking in 2014, according to the American Association of Poison Control Centers (AAPCC).⁴⁹ In 2014, more than half of these calls to poison hotlines were to report exposures among children under the age of six.⁵⁰ To begin to address the poisoning risk that e-cigarettes and liquid nicotine pose to young children, in 2016 Congress passed the Child Nicotine Poisoning Prevention Act, which gave the Consumer Product Safety Commission authority to enforce child resistant packaging standards for e-cigarette products. This law went into effect in July 2016.

Number of calls to poison control centers involving exposures to e-cigarette devices and liquid nicotine.

2011	271
2012	460
2013	1,543
2014*	4,024
2015*	3,774
2016*	2,886
2017*	2,452
Through Feb. 2018*	450

* Preliminary data, as poison centers continue to update their reports.

Population-Level Health Concerns

Youth and Young Adults. The number of youth using e-cigarettes raises serious concerns that e-cigarettes may function as a gateway to the use of more dangerous, combustible tobacco products. The Surgeon General found that while more research is needed, e-cigarette use is “strongly associated” with the use of other tobacco products among youth and young adults, including conventional cigarettes.⁵¹ The NASEM report concluded that “[t]here is substantial evidence that e-cigarette use increases risk of ever using combustible tobacco cigarettes among youth and young adults.”⁵²

Dual Use and Cessation. Data show that the large majority of e-cigarette users (both adults and youth) report using both e-cigarettes and conventional cigarettes, raising additional concerns beyond the potential health effects of e-cigarettes alone.

The currently available data indicate that most e-cigarette users report using both e-cigarettes and cigarettes. A 2015 survey found that the majority of current e-cigarette users (58.8 percent) were also current smokers.⁵³ Earlier data from 2014 found that nearly half (47.6 percent) of current smokers reported having ever tried e-cigarettes, with 15.9 percent of smokers reporting that they also currently use e-cigarettes.⁵⁴ The same survey found that 20.3 percent of smokers who had tried to quit smoking in the past year and 22 percent of recent former cigarette smokers (those who quit smoking within the past year) currently used e-cigarettes.

Some e-cigarette users report that they believe that e-cigarettes will help them quit or reduce the number of cigarettes they smoke.⁵⁵ However, there is not enough evidence to conclude whether e-cigarettes are a safe and effective smoking cessation device.⁵⁶ The U.S. Preventive Services Task Force, which makes recommendations about the effectiveness of specific preventive care services after a thorough assessment of the science, concluded that “the current evidence is insufficient to recommend electronic nicotine delivery systems for tobacco cessation...”⁵⁷ The NASEM report concluded, “[o]verall, there is limited evidence that e-cigarettes may be effective aids to promote smoking cessation.”⁵⁸ According to researchers from the CDC, “There is currently no conclusive scientific evidence that e-cigarettes promote long-term cessation, and e-cigarettes are not included as a recommended smoking cessation method by the U.S. Public Health Service.”⁵⁹

Existing research is limited and provides mixed results about the effectiveness of e-cigarettes in helping current smokers successfully quit. Two randomized controlled trials found that e-cigarettes are moderately effective in helping smokers quit, with rates of cessation with e-cigarettes similar to rates of cessation with nicotine replacement therapy (NRT).⁶⁰ A 2014 longitudinal study of current smokers found that smokers who used e-cigarettes daily for at least one month were more than six times as likely to have quit smoking than those who never used e-cigarettes or only used them once or twice.⁶¹ Other studies have found that e-cigarette use is not associated with successful quitting, finding that e-cigarette users were not more likely to have quit smoking compared to non-users.⁶² Nationally representative cross-sectional studies have found an association between frequency of e-cigarette use and cessation behavior. One study found that daily e-cigarette users were significantly more likely than non-e-cigarette users to be former cigarette smokers and that smoking cessation was highest among daily e-cigarette users compared to any other demographic or behavioral subgroup.⁶³ Additional research shows that smokers who use e-cigarettes more frequently are more likely to have made a quit attempt than smokers who don't use e-cigarettes.⁶⁴

A study of current and former cigarette smokers found that e-cigarette users significantly reduced the number of cigarettes smoked per day compared to non-users, although at follow-up, e-cigarette users were not more likely to have quit smoking compared to non-users.⁶⁵ Reducing the number of cigarettes smoked is a good thing if it eventually leads to quitting completely. However, e-cigarettes could ultimately reduce the number of smokers who would otherwise quit if smokers continue to use them in addition to, and not instead of, regular cigarettes. This would have a negative impact on public health. Smokers who continue to smoke (even fewer cigarettes per day) but also use e-cigarettes will increase their individual risk if this delays or prevents cessation. The NASEM report stated that a “reduction in rate of smoking does not ensure reduction in tobacco-related harm” and that, “there is no available evidence whether or not long-term e-cigarette use among smokers (dual use) changes morbidity or mortality compared with those who only smoke combustible tobacco cigarettes.”⁶⁶ Furthermore, CDC has highlighted the importance of quitting cigarettes completely, not just cutting down. According to the CDC, “If you only cut down the number of cigarettes you smoke by adding another tobacco product, like e-cigarettes, you still face serious health risks. Smokers must quit smoking completely to fully protect their health – even a few cigarettes a day are dangerous.”⁶⁷

Several Surgeon General's Reports and other studies have indicated that the risk of cardiovascular disease and other smoking-related diseases depends largely on the length of time a person smokes, not just the number of cigarettes smoked. Compared to non-smokers, light and intermittent smokers are at greater risk for cardiovascular diseases, lung cancer and lower respiratory tract infections, among other

things.⁶⁸ Studies have found that smoking just one to four cigarettes a day increases the risk of developing or dying from heart diseases.⁶⁹ Thus, prolonging smoking, despite smoking fewer cigarettes from using e-cigarettes, will continue to put that person's health at greater risk than if he or she had quit smoking entirely.⁷⁰

Important unanswered questions:

- *What are the long term health impacts of e-cigarette use?*
- *Do e-cigarettes help smokers quit more effectively than FDA-approved cessation products?*
- *Currently, the majority of e-cigarette users also smoke cigarettes. Will most e-cigarette users continue to be dual-users, or will they switch completely and become exclusive users of e-cigarettes?*
- *Will e-cigarette marketing renormalize tobacco use?*
- *Research shows a strong association between e-cigarette use and subsequent combustible cigarette smoking among youth and young adults. Will that translate into increased smoking rates in the long-term?*
- *Do e-cigarettes draw former smokers back into nicotine addiction and potentially back to cigarette smoking?*

There are many important unanswered questions regarding the short and long-term impact that e-cigarettes may have on public health. Effective regulation is needed to minimize the potential harms of e-cigarettes and maximize the potential benefits.

Campaign for Tobacco-Free Kids, March 16, 2018

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